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MONTANA FACT FINDING COMMITTEE
on
HIGHWAYS, STREETS AND BRIDGES

E *NGINEERING*

PROCEDURES AND INSTRUCTIONS

FOR DETERMINING

COUNTY ROAD NEEDS

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FACT FINDING COMMITTEE
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ENGINEERING PROCEDURES AND INSTRUCTIONS
FOR DETERMINING
COUNTY ROAD NEEDS

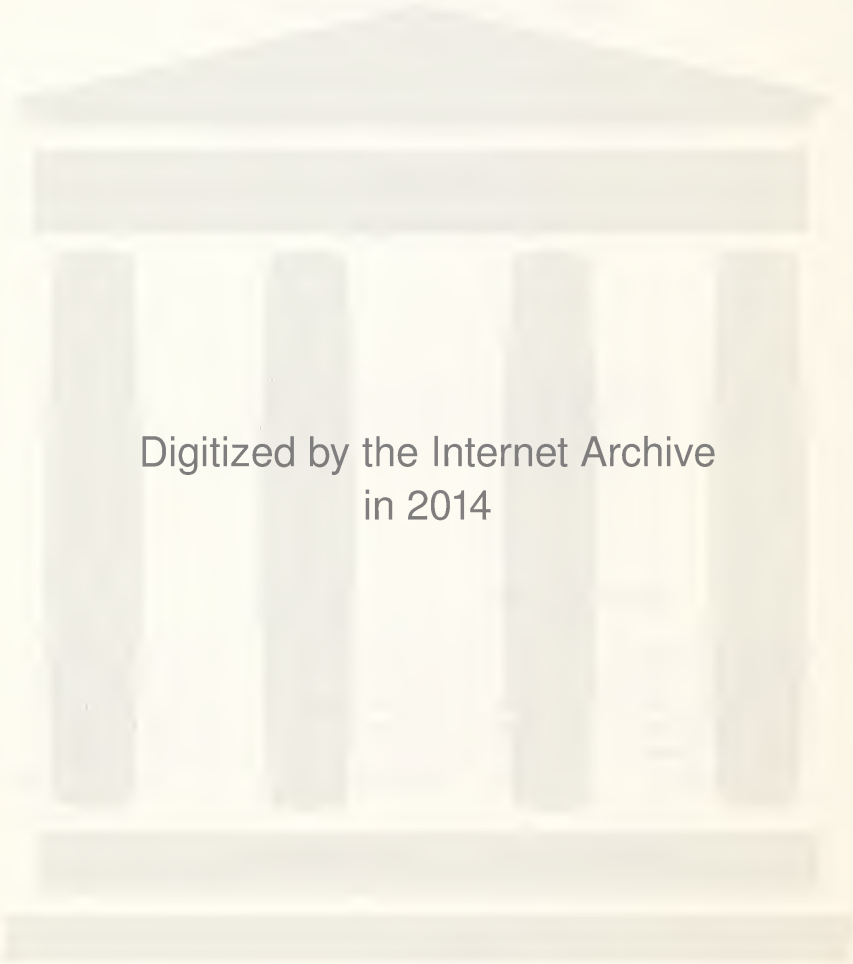
Prepared By The Engineering Staff
Of The Automotive Safety Foundation
With The Advice And Counsel Of The
County Engineer Advisory Committee

COUNTY ENGINEER ADVISORY COMMITTEE

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1956



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INTRODUCTION

Chapter 99 of the 1955 Session Laws of Montana created a Fact Finding Committee on Highways, Streets and Bridges to conduct a comprehensive study of highway, road and street needs of the State and to prepare a plan for an adequate highway program including county roads and city streets.

The Fact Finding Committee, acting through the Montana State Highway Commission, entered into an agreement on August 31, 1955, with the Automotive Safety Foundation of Washington, D. C., to supervise and direct an engineering study of highway and street needs and improvement costs. Concurrently, the Fact Finding Committee will conduct an independent, but related, study of highway finances.

This manual, outlining procedures and instructions of appraisal of county road needs, has been prepared with the advice and help of the County Engineer Advisory Committee to insure uniformity in the accumulation, tabulation and analysis of data and to establish and define standards for measurement of county road needs. Not only has the County Engineer Advisory Committee assisted in development of this manual, but it will continue as a group and individually to assist during the course of the engineering study. The Automotive Safety Foundation is responsible for direction of the study in accordance with these procedures, for methods of analysis, review of interpretations, conclusions, recommendations and contents of reports.

Since all roads and streets are essential to an integrated motor vehicle transportation system, it is necessary to determine needs on all roads and streets in order to establish proper legislative and fiscal policies. Separate manuals of procedure, for appraisal of State Highway needs and municipal street needs, have been prepared with the assistance of the State Engineer Advisory Committee and the City Engineer Advisory Committee respectively.

The appraisal procedures have been prepared in as much detail as possible with consideration being given to all information available. The determination of deficiencies and needs is not a mechanical process, however, and therefore the procedures must be considered in the nature of guides. There will be exceptional situations and borderline cases where the manual will not wholly apply. In such cases, it is important that sound engineering judgment be exercised. When conditions require deviation from the manual, the reasons should be clearly and concisely explained.

GENERAL PROCEDURE

The appraisal procedures and standards outlined in this manual are based upon an engineering approach to the determination of present and future county road needs. It is to the interest of each county that their road needs be completely and factually determined in accordance with the prescribed procedures. To do so will require that much of the basic field work be performed, data recorded and improvement costs estimated, by competent and experienced engineers.

Since many Montana counties do not have a county engineer, arrangements have been made for the assistance of the State Highway Department Division Construction Engineers in the determination of road needs in each county. County engineers, where available, are expected to assume basic responsibility for the appraisal of road needs in their county and to work closely with the State Division Construction Engineers. For all counties not employing a county engineer, the State Division Construction Engineers will be responsible for the needs appraisal. It is intended, in such cases, that they work closely with the county road superintendents, county commissioners and other county officials familiar with county road problems.

The procedures for appraisal of county road needs involve:

- A. Selection of a system of principal feeder roads in each county which perform collector and distribution service as distinguished from roads primarily providing local service or access to the land.
- B. Completion of data sheets for routes included in the selected feeder or secondary system, showing present status, existing deficiencies and character and cost of improvements needed.
- C. Appraisal of county local roads and determination, by mass analysis, of the annual cost to improve to adequate standards.

The engineering staff is confronted with the task of compiling data and analyzing needs for all Montana highways, roads and streets totaling approximately 72,500 miles in length. To accomplish this within the time available, it is necessary that the staff have the cooperation of all agencies involved. A series of meetings will be held as soon as possible after distribution of this manual to review procedures in detail and work out arrangements with each county for assistance of State Highway Division Construction Engineers where needed.

Members of the engineering staff will visit as many counties as possible during the course of the field work to review progress and offer assistance. In the meantime, if any questions arise, please write or call

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CLASSIFICATION OF ROADS FOR STUDY PURPOSES

Highway classification is the orderly grouping into systems of roads and streets providing similar services to the public. It is the framework around which highway responsibilities can be established, realistic improvement programs developed, a sound financial plan devised and organization and management requirements defined.

The rural highway classification plan adopted for this study is designed to group the entire 71,000 miles of rural roads in Montana into three interconnected systems:

- (a) A Primary System providing state-wide service
- (b) A Secondary System of principal feeder roads to the Primary System, and
- (c) Local rural roads providing access to the land primarily.

The Primary system comprises those routes of predominant interest to the State as a whole. They are identified by their location in connecting the principal communities of the State and those of neighboring states; by the greater volumes of traffic served; by their superior services to the national defense; and by the State's obligation to provide an interconnected network of roads serving all areas of the State within reasonable distance while at the same time doing so with the least mileage which will achieve these objectives.

The Secondary system comprises those routes in each county, other than the Primary system routes, (State Highways), which are of predominant interest to the county, or adjacent counties, as a whole. Criteria used in the selection of the Secondary system in each county include:

- 1. Carry relatively more traffic than other roads in the area,
- 2. Connect places of community interest such as schools, rural churches, railheads, grange halls, etc.,
- 3. Service cities and unincorporated towns and villages,
- 4. Function as main farm-to-market, mine, recreational, and logging arteries,
- 5. Carry principal mail, school bus, and milk routes,
- 6. Provide for a fairly uniform distribution over any area with density of pattern of the system varied in relation to population density,

7. Serve as collectors of traffic for several purely local land access roads.

Local rural roads include all remaining public roads not classified in the selected Primary and Secondary systems.

Pre-Classification

All rural roads in each county have been tentatively classified by the engineering staff into one of the three systems of the study classification plan following the criteria outlined. The Secondary system so selected in each county was submitted early in December, 1955 to the county commissioners for review. Following a series of meetings in each Financial District during December, 1955 and January, 1956 to consider criticisms and suggestions on the tentative pre-classification selections, a study Secondary system for each county has been established by the engineering staff.

SELECTION OF THE PROPOSED SECONDARY SYSTEM
IS FOR STUDY PURPOSES ONLY. IN NO WAY DOES
THE SELECTION OF THIS SYSTEM ALTER OR OTHER-
WISE AFFECT THE LEGAL STATUS OF PRESENT STATE
AND COUNTY ROADS. THE STUDY CLASSIFICATION
WILL SERVE AS THE BASIS FOR TABULATION OF
NEEDS OF RURAL ROADS.

The proposed Secondary system for all counties total about 11,600 miles in length, or approximately 16 percent of all rural road mileage of the State. In combination the Primary and Secondary systems comprise about 24 percent of all rural road mileage but carry approximately 93 percent of all rural travel.

Two sets of county maps have been prepared showing in red the proposed Secondary system and the route numbers to be used for identification purposes. The existing Federal Aid Secondary routes have retained their assigned route numbers while those additional Secondary study system roads have been assigned numbers above 500. One set of maps shall be used for identification during appraisal, and the other is to be retained by the county for their records.

APPRAISAL PROCEDURE

General

Secondary System

The study Secondary system is to be appraised section by section, to determine the construction needs and estimated costs of bringing the system to standards adequate to serve estimated 1976 traffic requirements.

Forms ASF-C1 and ASF-C2 are to be used for appraisal and recording of needs of Secondary routes in rural areas and in incorporated places of less than 5,000 population. The needs of Secondary routes in municipalities of 5,000 population and over will be established in connection with the municipal street appraisal through cooperative study with the city engineers and other city officials, representatives of the county involved, the State Highway Department, and members of the engineering staff.

Local Rural Roads

Local rural road needs are to be appraised by mass analysis procedures to determine the annual cost to improve to adequate standards. This analysis will be made by the engineering staff based upon inventory records of the Highway Department and reports from the individual counties on local road usage. The results of this analysis will be reviewed with the County Engineer Advisory Committee.

Secondary System Appraisal

On Secondary routes the method to be used in determining construction needs recognizes that many portions of the existing routes, though not developed to modern design standards, nevertheless are now reasonably adequate to serve present traffic. The first step in the appraisal procedure for Secondary routes is a determination for each route section of:

- (a) Its adequacy to handle today's traffic
- (b) Its adequacy to handle future traffic for a 20-year period.

Road sections inadequate for today's traffic represent a backlog of improvement needs. In order that these needs may be determined in a uniform and systematic manner, minimum conditions that are considered tolerable for today's traffic have been established. These are shown in Table I. The tolerable conditions vary for different types of terrain and for different traffic volume groups.

Road sections meeting tolerable conditions are considered adequate for today's traffic. These sections are to be appraised as to future deficiencies and improvements required to bring them to design standards.

Construction needs to overcome both present and future deficiencies are to be based on the design standards for Secondary Highways shown in Table II. Needed improvements on road sections not meeting tolerable conditions represent backlog needs and are to be classed as "deficient now." Needed improvements to overcome future deficiencies are to be grouped into time periods of 1-5 years, 6-10 years, 11-15 years, and 16-20 years based upon the degree of inadequacy and relative urgency of the required improvements.

Responsibilities and Schedule

The preparation of work sheets, forms ASF-C1 and ASF-C2, for appraisal of Secondary system routes involves four basic steps. These steps for each road section are:

- (1) Recording of identification information and road structure and traffic data;
- (2) Determination of the character and degree of deficiencies and estimating the time period in which required improvement should be made;
- (3) Determination of the type and estimated cost of improvement required to correct the deficiencies; and
- (4) Review of completed work sheet for conformity with procedures and instructions.

Step 1 is the basic responsibility of the Highway Planning Survey Division of the State Highway Department. Steps 2 and 3 are the basic responsibility of the county engineers and the State Highway Department Division Construction Engineers. The Division Engineers are being furnished with duplicate copies of forms ASF-C1 and ASF-C2 for each road section, structure, and railroad crossing showing information compiled from Department and Highway Planning Survey records as a result of step 1. This will serve primarily to identify the section to be appraised, and furnish pertinent data relative to traffic and surface types. Step 2 will generally require field inspections to determine the structural and geometric condition of each road section except in those cases where the county engineer or Division Construction Engineer is personally familiar with the current situation. Step 3 will require the combined engineering judgment of the county engineer, other county officials, and the Division Construction Engineer in determining applicable standards and estimating costs, with guidance from tables set forth in this manual. Step 4 is the basic responsibility of the engineering staff.

Step 1 is to be completed for all road sections by March 15, 1956. Steps 2 and 3 are to be completed by county engineers and Division Construction Engineers on or before April 15, 1956. The review process, step 4, is to be completed by May 15, 1956. The work sheet data will then be coded and compiled into the final report by the engineering staff.

Preparation of Work Sheets

Detailed instructions for preparation of work sheet forms ASF-C1 and ASF-C2 are given starting on page 15.

Step 1 - Identification, Classification, Road and Traffic Data

(A) Identification

The road section covered by each form ASF-C1 is described under the heading Identification. Road section limits occur at county lines, major road intersections, and at places where there are significant changes in traffic usage or physical characteristics. Road section limits also occur at the boundaries of all incorporated places in order to permit tabulation of data according to incorporated or rural areas.

No ASF-C1 or ASF-C2 sheets will be prepared for road sections within the city limits of municipalities having a 1950 census population of 5,000 or over. These sections will be appraised during the Municipal Street Needs study.

Road sections on boundaries of incorporated areas will be classified rural or urban, as the case may be, in accordance with the established practice of the Highway Department.

Within each road section covered by a work sheet form ASF-C1, a separate form ASF-C2 will be prepared for each structure of 20 foot span or more and for each railroad grade crossing.

(B) Classification

Item 8 of the work sheets refers to the highway study classification by the engineering staff. The Primary system box will be used only in case the classification study indicates certain existing county roads should be reclassified. Work sheets for such routes will be completed by the State Highway Department.

All work sheet forms ASF-C1 and ASF-C2 will be checked in the appropriate box under item 8 and under item 9 to indicate study system and Federal aid system classification. The boxes under item 10 will be used only to indicate "other Federal" systems overlapping the various Federal-aid highway systems.

(C) Road and Traffic Data - ASF-C1 (Existing Conditions - ASF-C2)

Physical status of existing facilities and traffic data are to be secured from Department and Highway Planning Survey records or from special studies. The status to be reported on each work sheet is that as of January 1, 1956, or as of completion of contracts awarded by that date. For contracts awarded subsequent to January 1, 1956, conditions should be reported as of January 1, 1956, with a note telling nature of work under contract.

In special cases 1955 traffic data, item 21 form ASF-C1, should be adjusted to a probable value on assumption that certain new facilities to be built will change the traffic pattern on the existing facility. Existing traffic will be used for rating purposes in such cases; adjusted traffic will be used for determining needed improvements.

Items 15, 16, 17 and 18 on form ASF-C1, relative to estimated remaining life of bituminous surface, surface condition, alignment and gradients are to be filled in by county engineers and Division Construction Engineers.

Step 2 - Character of Deficiencies and Time of Improvement

Before starting to complete steps 2 and 3 of the appraisal, county engineers and Division Construction Engineers are requested to review the information recorded on forms ASF-C1 and ASF-C2 under step 1. In some cases information available from central office records is incomplete. In particular, this applies to items 15 and 17, form ASF-C2. Fill in any missing data and note any discrepancies in the information shown on the forms from actual conditions by red pencil.

Each of the basic elements listed under items 23 to 29 form ASF-C1 and items 24-28 of form ASF-C2 are to be rated as to present degree of adequacy. Ratings will apply to the existing facility and traffic, even though the solution to severe inadequacy may be to relocate on wholly new alignment. This applies also to any projected locations which may be selected as a result of the highway classification study.

Tables to guide judgment of road and structure adequacy are contained in the appendix of this manual. In application of the guides, the physical status of each road section and structure must be compared with the appropriate minimum tolerable conditions and design standards.

(A) Time of Improvement

All Secondary system road sections and structures substantially below tolerable conditions are to be classed as "deficient now." Improvements required to correct deficiencies in such cases represent a backlog of work which will be handled separately in the long range program analysis.

Practically all Secondary routes now meeting the tolerable conditions of Table I are presently below the design standards shown in Table II and will require improvement during the 20-year study period. The deficiencies on some sections are more critical than on others, and in scheduling future improvements by the four five-year time periods of 1-5 years, 6-10 years, 11-15 years, and 16-20 years, consideration must be given to the degree of inadequacy that presently exists.

As a first step in timing of future improvements, it is requested each county make a preliminary determination of the relative degree of present deficiency of each secondary route by indicating on a county map the overall condition as one of four broad priority groups: Very Poor, Poor, Fair or Good. This should be done based on the engineers knowledge of physical condition, traffic usage, present maintenance requirements and problems on each route. This does not mean that the Secondary system should be divided equally among the four priority groups. In all probability a greater proportion of the Secondary routes will fall in the first priority group. The remainder should be classified in either the second, third or fourth priority groups depending on the degree of deficiencies, except that there may be some roads that recently have been constructed to high standards where soil conditions and traffic are such that they will remain adequate for traffic throughout the 20-year program period.

This preliminary analysis will serve as a guide of the time period in which the future improvement of road sections now tolerable should be made. Further detailed study of each road section and structure, at the time forms ASF-C1 and ASF-C2 are filled out, may indicate a greater or lesser urgency of improvement depending upon the character and degree of deficiencies.

Step 3 - Proposed Improvements and Costs

When determining design data for proposed improvements, careful consideration should be given to the terrain class since this has an important bearing, both on design standards, Table II, and the tolerable conditions, Table I. The indicated terrain class is based on prevailing conditions for the area traversed by a route. In order to obtain continuity in design the terrain class applicable to the major portion of the distance over rather long sections of a route should control. Generally the terrain class should not vary back and forth from flat to rolling, or rolling to mountainous, etc., on adjoining road sections.

For the purposes of this study terrain class is the local ground area traversed by the route with respect to differences in elevation only. The general contour of the area not affecting the road should be disregarded. The three terrain classes are defined as follows:

Flat is that where extended sight distances, both horizontal and vertical, are or could be obtained without construction difficulties.

Rolling is that where the differences in elevations with respect to an existing highway are or would be gradual; where frequent long sight distances, both horizontal and vertical, are or could be obtained with reasonable economy.

Mountainous is that where changes in elevation, longitudinal and transverse, with respect to an existing or proposed highway are or would be abrupt; where the roadbed was or would be obtained by frequent benching or sidehill excavation.

County Engineers and Division Construction Engineers should indicate the governing terrain class for each road section by check mark in the appropriate space on form ASF-C1.

(A) Proposed Improvements

Design standards shown in Table II are to be used in determining the nature of improvements needed within the 20-year study period. Chief factors in selection of the appropriate design standards to be used are:

(a) Estimated 1976 A.D.T.

(b) Terrain class

The engineer should estimate 1976 average daily traffic for each road section or route. Estimates by the Highway Planning Survey indicate an average 80 percent State-wide traffic increase over present volumes by 1976. This estimate of 80 percent increase may be used as a guide. Where there is reason to believe that a greater or lesser increase may occur, such value should be used with reasons noted on the back of the work sheet.

The design standards are to be supplemented by other factors which in good engineering practice will provide sound realistic estimates. Cost of correcting excessive maintenance conditions, low grade lines, poor drainage and other like conditions which are difficult to define in tabular form are important factors to be considered.

The type of work proposed should make maximum use of the existing facility where it is or can be made reasonably consistent with the standards indicated. Provision is made in items 31 to 34, form ASF-C1, to show various categories of work involved to the extent that it is needed.

When conditions appear to demand a different standard than proposed by Table II, county engineers and Division Construction Engineers should use their judgment. Lower standards are not expected in most cases but special conditions may include the following:

(a) Completed plans conforming substantially to appropriate design standards,

- (b) Unusually difficult terrain or right-of-way problems,
- (c) Need for continuity in route development,
- (d) Changing economy of an area.

Rural standards should be used for improvements within small cities between corporate limits and the beginning of the built-up areas. Improvements within built-up areas should be based on the design standards and guides included in the Municipal Street Manual. Municipal street standards should also be used for improvements required on Secondary routes in developed suburban areas adjacent to larger cities.

Replacement of existing bituminous surfaces should be scheduled when the life of the present mat indicates replacement will be necessary. Second generation replacements of bituminous mats will be estimated by the engineering staff and should not be included in the field appraisal.

(B) Cost Estimates

Construction costs vary greatly in different areas of the State and unit prices used for estimating improvement costs should be adjusted accordingly. Cost estimates are to be based on 1955 contract unit prices and the design standards and principles set forth in this manual, with due regard for salvage values in present facilities. Preliminary and direct project engineering costs are to be included as a percentage (average 10 percent) of construction costs.

Average 1955 construction costs for FAS contracts by types of work are shown on page 24. These averages are to be used only as guides and should be modified to meet local conditions. The basis for the cost estimate computation should be entered on the back of the work sheets. In transfer of the cost estimate computations to the face of the work sheets, the estimates should be rounded and entered to the closest thousand dollars.

The originals of the work sheet forms ASF-C1 and ASF-C2 should be returned to the engineering staff not later than April 15, 1956. All forms ASF-C2 covering structures and railroad grade crossings within a road section should be stapled to the form ASF-C1 for the road section.

Duplicate copies of forms ASF-C1 and ASF-C2 should be retained by the Division Construction Engineers for use in case of questions arising from review and analysis. Should they later be desired by the county for their records, they may be released after completion of the review process.

MONTANA FACT FINDING COMMITTEE
ON
HIGHWAYS, STREETS, AND BRIDGES
AUTOMOTIVE SAFETY FOUNDATION, CONSULTANTS

Table I

TOLERABLE CONDITIONS FOR SECONDARY HIGHWAYS

1955 ADT		400 - 1000 ①			200 - 400			100 - 200			50 - 100			25 - 50			Under 25		
Terrain Class		Flat	Rolling	Mts.	Flat	Rolling	Mts.	Flat	Rolling	Mts.	Flat	Rolling	Mts.	Flat	Rolling	Mts.	Flat	Rolling	Mts.
Safe Driving Speed – MPH		40			40			30			30			30			25		
Surface Type (In Good Condition)		Type 3 Low Bituminous			Type 3 Low Bituminous			Type 4 Gravel			Type 4 Gravel			Type 4 Gravel			Type 5 Graded & Drained		
Surface Width – Feet		18			18			20			20			18			18		
Roadway Width – Feet		24			24			20			20			18			18		
Drainage		Culverts in Fair Condition and of Sufficient Capacity to Handle Runoff Flooding Adequate			Culverts in Fair Condition and of Sufficient Capacity to Handle Runoff Flooding Adequate			Longitudinal and Transverse Drainage Sufficient to Permit Vehicular Usage Except Under Very Adverse Conditions			Longitudinal and Transverse Drainage Sufficient to Permit Vehicular Usage Except Under Very Adverse Conditions			Longitudinal and Transverse Drainage Sufficient to Permit Vehicular Usage Except Under Very Adverse Conditions			Longitudinal and Transverse Drainage Sufficient to Permit Vehicular Usage Except Under Very Adverse Conditions		
Snow Control		Spotty Drifting Which Can Be Remedied By Snow Fence or Small Amount of Plowing			Spotty Drifting Which Can Be Remedied By Snow Fence or Small Amount of Plowing			Spotty Drifting Which Can Be Remedied By Snow Fence or Small Amount of Plowing			Spotty Drifting Which Can Be Remedied By Snow Fence or Small Amount of Plowing			Spotty Drifting Which Can Be Remedied By Snow Fence or Small Amount of Plowing			Spotty Drifting Which Can Be Remedied By Snow Fence or Small Amount of Plowing		
Bridges	Loading	H-15			H-10			H-10			10 Tons			10 Tons			10 Tons		
	Bridge Roadway Width (Feet)	Equal To Approach Surface Width – Min.18'			Equal To Approach Surface Width – Min.18'			18			18			18			1-Lane Bridge Acceptable		
	Vertical Clearance(Feet)	13.5			13.5			13.5			12.5			12.5			12.5		

① Use Tolerable Conditions for Rural State Highways When 1955 ADT Exceeds 1000

MONTANA FACT FINDING COMMITTEE
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Table IV

DESIGN STANDARDS FOR SECONDARY HIGHWAYS

1976 ADT	400 to 1000①						200 to 400			100 to 200			50 to 100			25 to 50			Under 25																								
Terrain Class	Flat	Rolling	Mts				Flat	Rolling	Mts	Flat	Rolling	Mts	Flat	Rolling	Mts	Flat	Rolling	Mts	Flat	Rolling	Mts																						
Design Speed – MPH	60	50	45	50	45	40	45	40	35	40	30	25	40	30	25	40	30	25	40	30	25																						
Surface Type	Type 2 Intermediate Bituminous			Type 3 Low Bituminous			Type 3 Low Bituminous			Type 3 Low Bituminous			Type 4 Gravel – Heavy Course			Type 4 Gravel – Medium Course			Type 4 Gravel – Light Course																								
Surface Width – Feet	24	24	24	24	24	22	24	24	22	24	24	22	22	22	20	22	22	20	20	20	20																						
Roadway Width – Feet	32	32	28	30	30	26	28	28	26	24	24	22	22	22	20	22	22	20	20	20	20																						
Maximum Curvature – Degree	5	7	10	7	10	12	10	12	17	12	22	40	12	22	40	12	22	40	12	22	40																						
Maximum Gradient – Per Cent	5	6	7	5	6	7	5	6	7	5	7	9	5	7	9	5	7	9	5	7	10																						
Stopping Sight Distance – Feet	475	350	315	350	315	275	315	275	240	275	200	165	275	200	165	275	200	165	275	200	165																						
Minimum Right of Way Width–Ft	120						100			100			66			66			66																								
Bridges	H20–S16						H15–S12			H15			H15			H10			H10																								
	Loading						26			26			24			22			20																								
	Clear Width–Feet						14			14			14			14			14																								
Railroad Crossing Protection																						Grade Separation When Exposure Factor Exceeds 10,000 – Flashing Lights When Exposure Factor Exceeds 3,000 ReflectORIZED Warning Signs At All Other Crossings–[Exposure Factor = 1976 ADT X Trains per Day]																					

① Use Design Standards for Rural State Highways When 1976 ADT Exceeds 1000

② In Built-up Suburban Areas Use Municipal Street Standards

A P P E N D I X

INSTRUCTIONS FOR COMPLETING WORK SHEETS
Form ASF-C1

Item No.

1. Enter name of county.
2. Enter route number as assigned on county map. Federal-aid secondary routes will retain Federal-aid route numbers. Additional routes will be numbered over 500.
3. Enter section number as shown on county maps. Assign section numbers consecutively starting with "1" for each route.
4. Termini - Give a brief description of the location of the road section, using local names identifiable on the county map.
5. Check appropriate box to indicate road section location in rural or incorporated area. Do not combine rural and incorporated sections in one work sheet. Do not prepare work sheets for secondary roads in incorporated places of 5,000 population and over.
6. Enter length of road section to nearest one-hundredth of a mile.
7. Enter place name if road section is within an incorporated place of less than 5,000 population.
8. Check appropriate study system as determined from special highway classification study.
9. Check present Federal-aid system designation.
10. Check appropriate box if another Federal system classification overlaps one of the various Federal-aid highway systems. If no duplication, leave item 10 blank.
11. Present surface type classified according to the definitions on page 21.
12. Enter present surface width in feet. (average)
13. Enter total roadway width, out to out of shoulder. (average)
14. For bituminous surface or higher, enter approximate year built.
15. Enter estimated remaining years of surface life based on field check of condition. Applies to bituminous surfaces only. Do not rate gravel surfaces.
16. Check appropriate box.

WORK SHEET FOR DETERMINING
SECONDARY ROAD NEEDS
MONTANA FACT FINDING COMMITTEE
ON
HIGHWAYS, STREETS, AND BRIDGES

Form ASF-CI

AUTOMOTIVE SAFETY FOUNDATION, CONSULTANTS

Card Control 3 1

IDENTIFICATION				DO NOT WRITE IN THIS SPACE		
1. County _____ 2. Route No. _____ 3. Section No. _____				1		2-4
4. Termini _____				2-3		5-9
5. Location: Rural ☐ Incorporated ☐ 6. Length _____ Miles				5-6		10-14
7. Incorporated Place (Name) _____				7		15-17
CLASSIFICATION						
8. Study System _____ 9. Federal Aid System _____ 10. Other Federal (Duplicating) _____				8		18
Primary ☐ Secondary ☐ Forest Highway System ☐ Other Federal Reservation ☐				9		19
Non-Federal ☐				10		20
ROAD AND TRAFFIC DATA						
Terrain Class: Flat ☐ Rolling ☐ Mountainous ☐				11		21
11. Surface Type _____ 16. Surface Condition: Good ☐ Fair ☐ Poor ☐				12		22-23
12. Surface Width _____ Feet 17. Alignment: Safe Speed _____ M.P.H.				13		24-25
13. Roadway Width _____ Feet 18. Gradients: Moderate ☐ Steep ☐ Very Steep ☐				15		26-27
14. Year Built (Bit. Surf. Only) _____ 19. No. of Bridges _____						28-29
15. Est. Remaining Surface Life _____ Years 20. No. of R.R. Grade Crossings _____ (Bit. Surf. Only)						
21. 1955 A.D.T. _____				21		30-34
22. Est. Percent Commercial Traffic: Low ☐ Medium ☐ High ☐						35-39
CHARACTER OF DEFICIENCIES						
Present Degree of Adequacy						40-44
Very Poor Poor Fair Adequate				23		45-46
23. Surface Type _____				24		47
24. Surface Conditions _____				25		48
25. Surface Width _____				26		49
26. Roadway Width _____				27		50
27. Horizontal Alignment _____				28		51
28. Gradients _____				29		52-53
29. Other (Specify) _____						
30. Time of Improvement _____ Deficient Now 1-5 Yrs 6-10 Yrs 11-15 Yrs 16-20 Yrs Over 20 Yrs				30		54
PROPOSED IMPROVEMENT						
Type of Work _____ Miles _____ Design Data _____				Special Case		55
31. Resurfacing and Minor Widening _____ 36. Surface Type _____				31-34		56
32. Base and Surface (Present Line and Grade) _____ 37. Surface Width _____ Feet				35		57-60
33. Reconstruction (Minor Line and Grade Changes) _____ 38. 1976 A.D.T. _____				36		61
34. New Construction (Relocation) _____				37		62-63
35. Total Length _____						64-65
COST ESTIMATE						
Thousands of Dollars				DO NOT WRITE IN THIS SPACE		
39. Right of Way \$ _____				39		66-68
40. Grading and Drainage \$ _____				40		69-72
41. Base and Surface \$ _____				41		73-76
42. Total \$ _____						
REMARKS						
_____						77-80

Prepared by _____ Reviewed by _____ Coded by _____

Item No.

17. Enter the estimated safe speed of the road section resulting from restrictions in sight distance because of alignment.
 18. Check appropriate box.
 19. Enter number of structures over 20 foot span within road section. Complete form ASF-C2 for each structure.
 20. Enter number of railroad grade crossings within road section. Complete form ASF-C2 for each crossing.
 21. Enter 1955 Average Daily Traffic over section.
 22. Enter low, normal, or high for estimated percent commercial traffic.
 - 23-29. Check appropriate box for each of the basic elements to indicate present degree of adequacy. The degree of adequacy for each element should be judged following the guides shown on page 22 of the appendix.
 30. Check appropriate box to indicate time of improvement. Road sections which fail in a substantial way to meet tolerable conditions (Table I) should be rated "deficient now." Road sections now tolerable should be scheduled for future improvement by time periods based on the present degree of inadequacy and should be done on as practical and realistic evaluation as possible. See discussion pages 9 and 10.
 - 31-34. Indicate type of work and length to nearest one-hundredth of a mile. Where more than one type of work is proposed on a road section, the length of each type of improvement is to be entered.
 35. Enter total length of section to be improved. (Equals total of entries, items 31 to 34).
 36. Proposed surface type in accordance with definitions page 21.
 37. Proposed surface width in feet.
 38. Enter estimated 1976 average daily traffic. Estimates by the Highway Planning Survey indicate an average 80 percent State-traffic increase by 1976. Where there is reason to believe that a greater or lesser increase may occur, such value should be used with reasons noted on back of the work sheet.
 - 39-42. Cost estimates for the various items listed should be entered to nearest thousand dollars. See discussion page 12.
- Any additional information relative to the road section which might be of importance during review of the appraisal should be entered under "remarks."

The individual completing the field appraisal and cost estimate should initial the proper space at the bottom of the form.

INSTRUCTIONS FOR COMPLETING WORK SHEETS
Form ASF-C2

Item No.

1-5. Same as items 1 to 5 form ASF-C1.

- Enter bridge number starting with one for each road section.
- Enter railroad grade crossing number starting with one for each road section.

6. Enter overall length, in feet, back to back of abutments. For highway underpasses (railroad over highway) enter zero feet. For railroad grade crossings enter zero feet.

7-10. Same as items 7 to 10, form ASF-C1.

NOTE: Items 11-19 apply to structures only.

11-12. Check appropriate boxes.

13. Enter roadway width - curb to curb. For highway underpasses (railroad over highway) enter width between abutments or piers.

14. Enter number of spans for structures carrying highway. Leave blank for highway underpasses. (Railroad over highway)

15. Enter year built for structures carrying highway. Leave blank for highway underpasses. (Railroad over highway)

16. Enter minimum vertical distance above roadway surface to lowest point of overhead obstruction. Enter UL for deck type structure with no overhead obstruction.

17. Enter estimated safe load capacity for structure carrying highway. Leave blank for highway underpasses. (Railroad over highway)

18-19. Same entries as items 21-22, form ASF-C1.

NOTE: Items 20-23 apply to railroad grade crossings only.

20. Enter average number of trains per day.

21. Enter number of main line tracks.

22. Enter number of siding tracks.

23. Check appropriate box.

Item No.

- 24-28. Check appropriate box for each of the basic elements to indicate present degree of adequacy. The degree of adequacy for each element should be judged following the guides on page 23 of the appendix.
29. Check appropriate box to indicate time of improvement. See discussion item 30, instruction for form ASF-C1. All main line railroad crossings rated "poor" or "very poor" should be marked "deficient now." All other crossings requiring additional protection on the existing location should be marked for the 1-5 year period. When a new location is anticipated, the time period should be scheduled with the road section improvement. All existing structures rated "poor" or "very poor" on any item 25-28 should be marked "deficient now." All other structures should be scheduled to coincide with the road improvement, unless particular circumstances indicate that it is reasonable to postpone structure improvement to a later period.

NOTE: Items 30 to 36 apply to structures only.

- 30-31. Check appropriate boxes.
32. Enter general type of structure proposed; i.e., truss, concrete beam, etc.
33. Enter overall length to nearest foot.
34. Enter clear roadway width between curbs.
35. Enter design loading.
36. Same entry as item 38, form ASF-C1.

NOTE: Items 37-38 apply to railroad grade crossings only.

- 37-38. Check appropriate box to indicate type of protection proposed.
- 39-40. Cost estimates should be entered to nearest thousand dollars. See discussion page 12.

Any additional information relative to structures or railroad crossing protection should be entered under "remarks." If a structure is to be replaced with large pipe, appropriate notation should be made under "remarks," and the cost estimate included with "grading and drainage" on form ASF-C1.

The individual completing the field appraisal and cost estimate should initial the proper space at the bottom of the form.

SECONDARY ROAD STRUCTURE & RAILROAD PROTECTION NEEDS

MONTANA FACT FINDING COMMITTEE

ON

HIGHWAYS, STREETS, AND BRIDGES

AUTOMOTIVE SAFETY FOUNDATION, CONSULTANTS

Card Control 4 1

IDENTIFICATION		DO NOT WRITE IN THIS SPACE	
1. County _____	2. Route No. _____	3. Section _____	1
4. Termini _____			2-3
5. Location: Rural ☐ Incorporated ☐ Bridge No. _____ R.R. Crossing No. _____			5-6
6. Length _____ Ft.	7. Incorporated _____	Place (Name) _____	7
CLASSIFICATION			
8. Study System	9. Federal Aid System	10. Other Federal (Duplicating)	8
Primary ☐	Primary ☐	Forest Highway System ☐	9
Secondary ☐	Secondary ☐	Other Federal Reservation ☐	10
	Non Federal ☐		
EXISTING CONDITIONS			
11. Type of Service	12. Type of Structure	13. Roadway Width _____ Ft.	11
Stream Crossing ☐	Timber ☐	14. No. of Spans _____	13
R.R. Under Highway ☐	Concrete Slab ☐	15. Year Built _____	15
R.R. Over Highway ☐	Concrete T Beam ☐	16. Vertical Clearance _____ Ft.	17
Highway Separation ☐	Steel I Beam ☐	17. Safe Loading _____	23
	Steel Girder ☐	18. 1955 ADT (total) _____	18
	Steel Truss ☐	19. Est. Percent Commercial _____	
	Other (specify) _____	Low ☐ Medium ☐ High ☐	
Railroad Grade Crossing Only			
20. No. of Trains Per Day _____	23. Type of Protection		
21. No. of Tracks: Main _____	Signs Only ☐		
22. No. of Tracks: Sidings _____	Signals ☐		
	Signals & Gates ☐		
CHARACTER OF DEFICIENCIES			
24. R.R. Grade Crossing Protection	Present Degree of Adequacy		24
	Very Poor ☐	Poor ☐	25
25. Clear Width	☐	☐	26
26. Vertical Clearance	☐	☐	27
27. Structural Condition	☐	☐	28
28. Other (specify) _____	☐	☐	
29. Time of Improvement			29
	Deficient ☐	Now ☐	
	1-5 Yrs. ☐	6-10 Yrs. ☐	
	11-15 Yrs. ☐	16-20 Yrs. ☐	
	Over 20 Yrs. ☐		
PROPOSED IMPROVEMENT			
30. Type of Service	31. Type of Work	32. Type (specify) _____	Special Case ☐
Stream Crossing ☐	Recondition Existing Structure ☐	33. Length _____ Ft.	31
R.R. Under Highway ☐	Replace Same Location ☐	34. Width _____ Ft.	37-38
R.R. Over Highway ☐	Replace New Location ☐	35. Loading _____	33
Highway Separation ☐	New Structure ☐	36. 1976 ADT _____	30
			34
			35
RAILROAD GRADE CROSSING ONLY			
37. Signals Only ☐	38. Signals & Gates ☐		
COST ESTIMATE			
39. Structure	Thousands of Dollars \$ _____	DO NOT WRITE IN THIS SPACE	39
40. R.R. Protection	\$ _____		40
REMARKS			

SURFACE TYPE DEFINITIONS

<u>TYPE</u>	<u>SURFACE TYPE</u>	
1.	High	A Portland cement concrete, controlled plant mixed bituminous concrete, brick or block wearing surface on a base of sufficient thickness and subgrade of proper type to withstand the loads imposed by large volumes of mixed traffic having a high frequency of maximum legal axle loads.
2.	Intermediate	A flexible pavement of plant mixed bituminous or mixed-in-place bituminous wearing surface on a granular base of sufficient thickness and subgrade of proper type to withstand the loads imposed by mixed traffic having a moderate frequency of maximum legal axle loads.
3.	Low	A flexible pavement with a bituminous wearing surface one inch or less in thickness on a gravel or crushed stone base of sufficient depth to withstand the loads imposed by average daily commercial traffic.
4.	Traffic Bound	Gravel or crushed stone, stabilized or not stabilized, of sufficient thickness to carry the loads imposed by the traffic served.
5.	Graded and Drained Earth	A road of natural or stabilized earth on which sufficient work has been done to give reasonable line and grade and with cross and side drainage generally provided.
6.	Unimproved or Primitive	A road of natural earth of a lower type in respect to alignment, gradients and drainage than a "Graded and Drained Earth Road."

Roadway
Guides For Determining Degree of Adequacy
(Items 23-28, Form ASF-C1)

Item 23 - Surface Type	Degree of Adequacy
Meets Design Standards - Table II	Adequate
Meets Tolerable Conditions - Table I	Fair
Below Tolerable Conditions - Table I	Poor
Unimproved or Primitive, Types 5 or 6	Very Poor
Item 24 - Surface Condition (Based on Field Check)	
Good	Adequate
Fair	Fair
Poor	Poor
All Unsurfaced Roads Over 25 ADT	Very Poor
Item 25 - Surface Width	
Meets Design Standards - Table II	Adequate
Meets Tolerable Conditions - Table I	Fair
2 Feet Less Than Tolerable Conditions - Table I	Poor
More Than 2 Feet Less Than Tolerable Conditions - Table I	Very Poor
Item 26 - Roadway Width	
Meets Design Standards - Table II	Adequate
Meets Tolerable Conditions - Table I	Fair
2 Feet Less Than Tolerable Conditions - Table I	Poor
More Than 2 Feet Less Than Tolerable Conditions - Table I	Very Poor
Item 27 - Horizontal Alignment	
Meets Design Standards - Table II	Adequate
Meets Tolerable Conditions - Table I	Fair
Safe Speed 5 MPH Less Than Tolerable Conditions - Table I	Poor
Safe Speed More Than 5 MPH Less Than Tolerable Conditions - Table I	Very Poor
Item 28 - Gradients	
Meets Design Standards - Table II	Adequate
Gradients, item 18, Rated "moderate" But Under Design Standards	Fair
Gradients, item 18, Rated "steep"	Poor
Gradients, item 18, Rated "very steep"	Very poor

Structures And Railroad Crossings
Guides For Determining Degree of Adequacy
(Items 24-27, Form ASF-C2)

Item 24 - R. R. Grade Crossing Protection	Degree of Adequacy
Signals over 3000 Exposure Factor	
Reflectorized Signs Under 3000 Exposure Factor	Adequate
Crossing and Advance Warning Signs Only (not reflectorized)	Fair
Crossing Signs Only	Poor
No Signs, Or Meets Warrants For Railroad Separation Structure	Very Poor
Item 25 - Clear Width	
Meets Design Standards - Table II	Adequate
Meets Tolerable Conditions - Table I	Fair
Less Than Approach Surface Width	Poor
1 Lane Bridges (except 1955 ADT Under 25)	Very Poor
Item 26 - Vertical Clearance	
Meets Design Standards - Table II	Adequate
Meets Tolerable Conditions - Table I	Fair
1 Foot Less Than Tolerable Conditions	Poor
Less Than 12.5 Feet	Very Poor
Item 27 - Structural Condition	
(Do not rate Highway underpasses - R. R. Over Highway)	
Meets Design Standards - Table II	Adequate
Meets Tolerable Conditions - Table I	Fair
H 10 - ADT over 400 or	
5 Tons - ADT less than 400	Poor
Less Than 5 Tons	Very Poor

MONTANA FACT FINDING COMMITTEE
ON
HIGHWAYS, STREETS, AND BRIDGES
AUTOMOTIVE SAFETY FOUNDATION, CONSULTANTS
GUIDE FOR ESTIMATING NEW CONSTRUCTION COSTS
OF SECONDARY HIGHWAYS

ROADWAY – Dollars per Mile																								
Grading	1976 ADT			400 – 1000			200 – 400			100 – 200			50 – 100			25 – 50			UNDER 25					
	Terrain Class			Flat	Rolling	Mts	Flat	Rolling	Mts.	Flat	Rolling	Mts.	Flat	Rolling	Mts	Flat	Rolling	Mts.						
	Soil			6600	8700	15400	5800	7300	12000	5000	6000	9300	3800	4300	5600	3100	3500	4900	2500	3000	4000			
	Moderate Rock			7900	14400	28800	6900	12000	22600	5800	9900	17400	4500	7000	10700	3500	5800	9400	2900	5000	7500			
	Predominant Rock			—	19200	43800	—	16100	34200	—	13200	26600	—	9500	16200	—	7700	13900	—	6600	11400			
	Below Average Drainage			2300	2800	3000	2100	2300	2500	1900	2100	2200	1700	1800	1900	1600	1700	1800	1500	1600	1700			
	Moderate Drainage or Irrig			3700	4500	4700	3400	3700	4000	3000	3400	3600	2700	2900	3100	2500	2700	2900	2300	2600	2800			
Base	Intense Drainage or Irrig			5500	6700	7100	5000	5500	6000	4500	5000	5400	4000	4400	4700	3700	4000	4400	3500	3900	4200			
	Good Subgrade			9200	9200	8100	7000	7000	6000	5100	5100	4800	2200	2200	2000	1400	1400	1200	—	—	—			
	Average Subgrade			12900	12900	11300	9900	9900	8600	7800	7800	7200	3600	3600	3300	2700	2700	2500	1200	1200	1200			
Base	Poor Subgrade			16600	16600	14500	12900	12900	11200	10300	10300	9600	5000	5000	4600	3900	3900	3500	2500	2500	2500			
	Surface			8400	8400	8400	3800	3800	3500	3800	3800	3500	2900	2900	2700	1800	1800	1600	1600	1600	1600			
STRUCTURES – Dollars per Lineal Foot																								
Concrete and Steel				650			585			540			500			—			—					
Timber				—			300			275			250			235			220			200		
RAILROAD GRADE CROSSING PROTECTION																								
Flashing Signals				6000																				
Flashing Signals and Gates				7500																				

RIGHT OF WAY														Land Estimates are on Acreage Basis and Fencing on a Roddage Basis									
Grazing			Pasture			Tillable			Irrigated				Fencing										
Poor	Good		Dry	Sub-Irrigated	Irrigated	Non-Cultivated	Cultivated	Hay	Grain	Beets Garden	4-Wire	Woven Wire	Resetting										
1000	2500		2500	6000	8000	5000	7500	8000	12500	30000	2 00	2 75	1.50										

NOTE : Drainage Estimating Guides Are Based upon Normal Size Pipes Through 60" Diameter - when Larger Diameters Are Proposed, the Drainage Estimate Should be Increased Accordingly. Estimated "in Place" Cost of Larger Pipes Are : 90" Diam. - \$60/lin. ft, 120" Diam - \$72/lin. ft, 150" Diam. - \$95/lin. ft, 180" Diam. - \$115/lin. ft.

All Construction Cost Guides Are Based upon New Construction. If the Proposed Improvement Will Salvage Portions of the Existing Facility, Appropriate Cost Reductions Should be Made.

10% Estimated Project Engineering Cost Has Been Included in the Estimating Guides.

